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A CASE OF ABNORMAL PLUMAGE.

R. M. STRONG.

The purpose of this paper is to describe a case of abnormal plumage. The material was obtained from a hybrid pigeon belonging to Professor C. O. Whitman, which was reared at Woods Holl, Mass., in the summer of 1902. The male parent of the bird was a ring dove (*Turtur risorius*) and the female parent was a hybrid between a male little red ring dove of China (*T. humilis*) and a common ring dove (*T. risorius*).

The abnormalities under consideration occurred in the plumage succeeding the *natal* down, the so-called *juvenile* plumage of Dwight (:00), and they were of three distinct types, belonging respectively to the remiges, the rectrices and the body coverts.

1. *The Remiges.* — The remiges all had a transverse band of slightly paler color across the proximal portion of the distal half of the vane (see Fig. 1). The shaft, barbs and barbules were all more sparsely pigmented where this band occurred, and some of the barbules were represented only by stubs. This condition of the barbules is particularly noticeable at the proximal ends of the barbs whose insertions on the shaft occur in this region, and it will be considered in the description of abnormalities in the rectrices. The vane was also slightly narrower at this point. The position and character of this band were uniform in all of the remiges, though there were very slight variations in its paleness.

2. *The Rectrices.* — The rectrices were also crossed by a transverse band in a position similar to that noticed in the remiges, but the region is much more abnormal. The loss in pigmentation is greater than was the case in the remiges, and

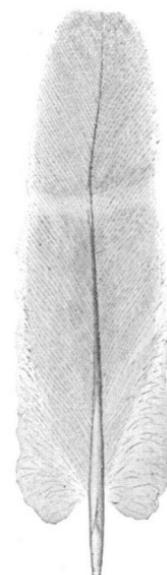


FIG. 1. Dorsal view of secondary from left wing of hybrid pigeon having abnormal plumage. $\times 1$.

there is an area of almost complete absence of normally formed barbules (Fig. 2). The barbules of both the distal and the proximal rows in this region were represented only by stubs of the proximal portions, and the stubs in the distal row were much shorter than those of the proximal row (Fig. 3). To the unaided

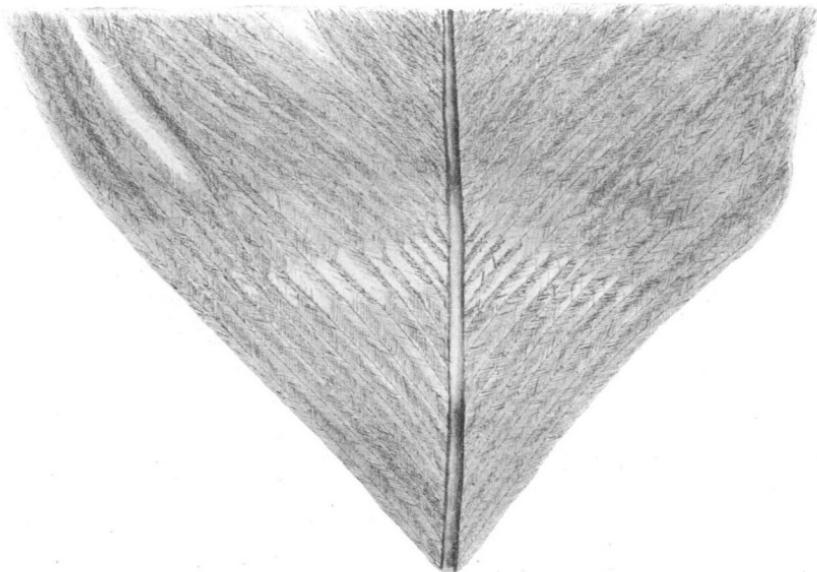


FIG. 2. Dorsal view of the abnormal region in one of the rectrices, the fourth from the left side of the tail. $\times 6$.

eye the vane appears loose in texture at this point and, as in the remiges, it is slightly narrower here.

It has been impossible to determine the histogenesis of these barbule stubs, but it seems to the writer unlikely that they represent the entire structure produced in the feather germ. The occurrence of barbules of normal appearance among the stubs with no intermediate conditions and the irregular fractured appearance of the distal ends of the stubs point strongly towards the conclusion that a distal portion has been broken away. There are a number of species of birds which normally have feathers with the barbules broken off at certain fairly definite points near their proximal ends in the distal portions of the more distal barbs as has been observed by Meves ('55), Chapman ('96), Dwight (:00),

and others, including the writer. The barb itself may be broken near the distal end according to Meves and Chapman. In these instances, the breaking is believed to occur some weeks or months after the feather was fully developed. In the case of these abnormal feathers, however, nothing is known as to the time when the barbules may have been broken, but the condition was observed only a few days after the feathers had emerged from the sheath enclosing the feather germ.

The Body Coverts.—The most striking type of abnormality appeared in the body coverts, and it is very different from what was seen in the remiges and rectrices.

A normal body covert of the juvenile plumage from another hybrid is shown in Fig. 4. The downy portion, *i. e.*, the part where the barbules are long and with rudimentary barbicels is represented diagrammatically.

The barbs or portions of barbs bearing shorter barbules with hooked barbicels usually, in the distal row, are indicated semi-diagrammatically by lines radiating from the shaft, but no attempt has been made to represent the true number of the barbules. It will be seen that by far the larger portion of the vane of such a feather is downy.

An abnormal feather from a corresponding region on the back of the bird under consideration is represented in Fig. 5. Almost the whole feather appears downy and there is a strange tassel-like appendage to the distal end of what may be called the main body of the feather. With the aid of a microscope, one finds that two or more of the more distal barbs are fused at their distal ends into a horny, unpigmented, irregularly-shaped cylinder (Fig. 5, *cyl.*), which branches at its distal end into several downy barbs and a median shaft that itself bears barbs on either side in

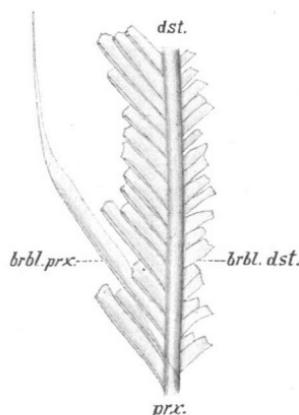


FIG. 3. Dorsal view of a portion of a barb bearing barbule stubs from the left side of the shaft in the region represented in Figure 2. $\times 74$. *brbl. dst.*, distal barbules; *brbl. prx.*, proximal barbules; *dst.*, distal end of portion of barb figured; *prx.*, proximal end of portion of barb figured.

the usual manner. The shaft of the main portion of the feather is not continuous, however, with the shaft of the distal appendage. The distal ends of the barbs nearest those actually fused with the horn cylinder have strips of horn tissue (Fig. 5, *a*), which seem to have been torn loose from the cylindrical mass with which they were probably fused in the feather germ.

Near the points where the barbs fuse with this horn cylinder, the barbules are less highly differentiated. The most distal barbules are comparatively irregular strips of keratin which may

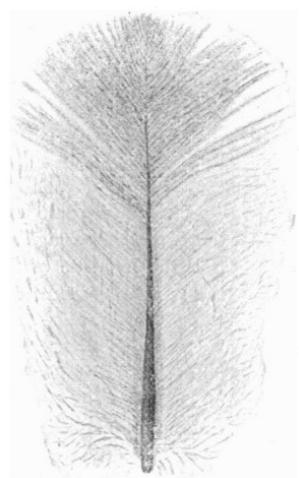


FIG. 4.

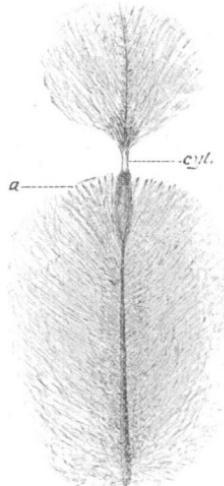


FIG. 5.

FIG. 4. Dorsal view of a normal body covert from the back immediately anterior to the upper tail coverts. $\times 2$.

FIG. 5. Dorsal view of an abnormal body covert from a region corresponding to that furnishing the feather shown in Figure 4. *cyl.*, horn cylinder; *a*, position of a fragment torn from horn cylinder. $\times 2$.

be fused at their distal ends with the cylindrical mass, as can be seen in Fig. 6 where two barbs and a barbule are shown fusing with a strip of tissue torn from the cylinder.

Discussion and Conclusions. — It is significant that these abnormalities occur at uniform distances from the distal ends of the feather throughout the whole plumage, and it seems reasonable to conclude that the conditions responsible for the abnormalities were constitutional, and affected the germs of all the feathers

simultaneously, though in three different degrees of intensity. The length of the period during which these conditions obtained is, presumably, approximately that required for the differentiation of a portion of the shaft equal to the band shown in Fig. 1.

Professor Whitman tells me that he once had a young common domestic dove which developed similarly abnormal feathers. This bird was underfed during the period when the *juvenile* plumage was developing. I am inclined to accept Professor Whitman's suggestion that in both cases the abnormalities are due to malnutrition. The effects upon the remiges and rectrices were comparatively slight, and appear simply as a weakening in pigmentation and structure, but the body coverts were strikingly modified.

The horn cylinder (Fig. 5, *cyl.*) is just such a structure as one would expect to find if the processes of differentiation in the fundament of the barbs and barbules, which have been described by Davies ('89), Strong (:02), and others were to be arrested temporarily. The shaft, barbs and barbules are developed in apartments of a cylindrical mass of epithelium surrounding a central dermal papilla, and differentiation takes place from the proximal end distally. Epithelial cells proliferated at the proximal end of the feather germ push the differentiating epidermal cylinder distally, and cornification takes place some distance from the proximal end. If the differentiation, but not the cornification, should be omitted, a simple cylinder of cornified tissue such as we see in the abnormal body coverts would result. The appearances at either end of the horn cylinder undoubtedly represent the end of differentiation distally, and at the proximal end (Fig. 6) the resumption of differentiation of the normal feather elements.

I wish here to express my thanks to Professor Whitman for the material described in this paper and for courtesies received in connection with the investigation.

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WOODS HOLE, MASS., September 4, 1902.



FIG. 6. Dorsal view showing fusion of two barbs and a barbule into a strip from the cylinder of undifferentiated cornified tissue which connects the distal appendage shown in Fig. 5 with the main body of the feather.
X 49.

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